भारतीय मानक
Indian Standard

IS 17880 : 2022

भुकृत्रिम — तटीय और जलमार्ग संरक्षण के लिए कृत्रिम बहुलक रस्सी के गेबियन — विशिष्टि

Geosynthetics — Synthetic Polymer Rope Gabions for Coastal and Waterways Protection — Specification

ICS 59.080.70

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Geosynthetics Sectional Committee, TXD 30

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Geosynthetics Sectional Committee had been approved by the Textiles Division Council.

Synthetic polymer gabions are collapsible sausages, which are pre-fabricated by a unique process in which the polypropylene ropes are woven into a continuous net with square apertures of 100 mm or 150 mm. The construction of the nets is woven having joints with intersection of the ropes to form square/rhomboidal mesh. The other construction types may be used to get uniform geometry of the net. These nets are used to form cages of desired sizes and are filled with boulders or geobags with soil material or concrete blocks or select fill obtained from demolition sites. Polymer gabions are manufactured from polypropylene ropes of diameter ranging from 8 mm to 16 mm. The diameter of ropes for the border and body of gabions and aperture size may vary being designed to conform and suit type of application, method of installation and expected load conditions. The ropes are adequately stabilized to minimize degradation against ultraviolet radiation. The ropes and ties used for manufacture of polymer gabions shall be black to enhance UV stability.

The polymer gabions are preferred for coastal protection works, the polymer being inherently inert to corrosive coastal environment. Polymer gabions are ideally suited for use as an armor layer in resisting virtually all the erodible effects of waves. Boulders or geobags with soil material or concrete blocks or select fill can be placed in-situ or gabions can be prefilled and installed in place with the help of for example a crane. Special care shall be provided during lifting of polymer gabions for installation so that ropes may not get damaged during the process. Adjacent units of polymer gabions are tied together to form a continuous monolithic structure.

Polymer gabions being more flexible, as compared to the steel wire gabions may not always be able to retain the intended shape due to the effect of waves, especially under repeated high tidal waves. Polymer materials are highly flammable and can catch fire easily, so the polymer gabions may be used for the underwater applications or where these materials are not directly exposed to flame or near flame.

The installation guidelines for polypropylene rope gabions are given in Annex J for information only and shall be suitably modified and applied to suit specific site conditions.

The composition of the Committee responsible for the formulation of this standard is given in Annex K.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

GEOSYNTHETICS — SYNTHETIC POLYMER ROPE GABIONS FOR COASTAL AND WATERWAYS PROTECTION — SPECIFICATION

1 SCOPE

1.1 This standard specifies requirements for synthetic polymer gabions made from polypropylene ropes, used for coastal and waterways protection applications, such as revetments, river training, construction of groynes, artificial reefs and toe retaining wall, etc in order to minimize soil erosion and control floods.

1.2 This standard does not cover requirements for other types of erosion control gabions, such as steel wire gabions, polymer tubular gabions, etc.

1.3 This standard does not cover requirements of geo synthetic filter fabric used to minimize pore pressure build up and erosion of the soil mass along the bank being protected by gabions.

1.4 This standard does not cover requirements to resist loads on the gabions caused by ship propulsion systems.

NOTE — The survivability/durability of polymer gabions depends upon water pressure, type of contents of polymer gabions that is boulders or cement cubes, water *p*H and temperature etc.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision ,and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMS AND DEFINITIONS

For the purpose of this standard, the following definitions shall apply.

3.1 Mesh — The size of the square in the gabions used as designation (type) of the gabion.

3.2 Opening Size — The average distance measured at right angles between the ropes over 10 meshes.

3.3 Polymer Gabion — A flexible, permeable monolithic structured basket or container made from an assembly of polymer ropes filled with soil contained geo bags, stones, or other suitable fill material and used mainly in civil/hydraulic engineering works, that is erosion control purposes, such as temporary retaining wall structures, sea walls, channel linings, revetments, offshore bunds, dykes and weirs.

3.4 Punching Shear Strength — It is a type of failure when the gabion net is subjected to high pulling forces. The failure is due to shear.

4 TYPES

4.1 Based on the aperture size of the netting used, the synthetic polymer rope gabions for coastal and waterways protection shall be classified as follows:

a) *Type 1* — Synthetic polymer rope gabions having aperture size of 100 mm; and
b) *Type 2* — Synthetic polymer rope gabions having aperture size of 150 mm.

5 MATERIAL

5.1 Material of Synthetic Polymer Rope Gabions

Synthetic polymer rope gabions shall be made from ropes manufactured from ultra violet stabilized polypropylene (*see* Note), depending upon the end use requirements and shall conform to the physical requirements as specified in Table 1. The rope used to manufacture these synthetic polymer gabions shall be 4 strand shroud laid. The colour of rope shall be black. The rope shall be inert to commonly encountered chemicals, resistant to rot and mildew, and shall have no defects which adversely affect or alter its physical properties.

NOTE — Other polyolefin material may be added to improve the mechanical properties of rope keeping polypropylene as major component.

6 MANUFACTURE

6.1 Netting

The polypropylene ropes shall be woven into a continuous integral structure by intersecting the one side of the ropes to the opposite direction of the rope to form netting of desired size. Then the ropes shall be spliced with the opposite direction's rope by splicing process. The splicing shall be such that it does not allow the slippage of rope end.

NOTE — Wherever there is splicing at ends, the mesh size tends to be higher than regular meshes as shown in Fig. 1.

6.2 Gabion

6.2.1 The synthetic polymer rope gabions shall be manufactured by holding the bottom and four sides together by appropriate intersection of ropes and with flip open top lid. Partitions shall be inserted at an interval of every 1 meter for gabions of length 2 m and above. The ends of the partitions shall be tied with bottom and adjacent walls by splicing method as shown in Fig. 1.

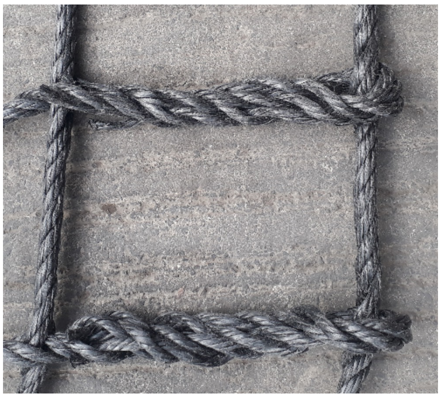


Fig. 1 Splicing at Ends

6.2.2 At the corners of the synthetic polymer rope gabions and at top edges of partition, extra length of rope shall be provided for hangs of minimum diameter of 200 mm as shown in Fig. 2. The hang length shall be minimum 1 m. The schematic diagram of synthetic polymer rope gabion is given in Fig. 3.

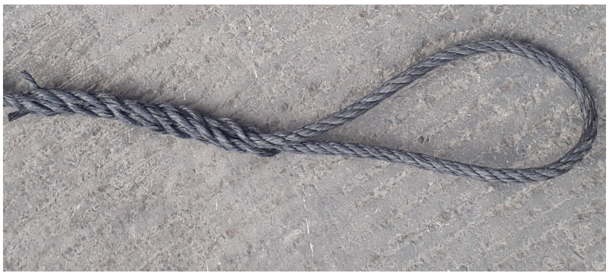


Fig. 2 Hangs

NOTE — The synthetic polymer rope gabions may be manufactured from other methods also provided it conforms to the requirements specified in Table 1.

6.2.3 *Sizes of Synthetic Polymer Rope Gabion*

The size of the synthetic polymer rope gabion in terms of length (l) × width (w) × height (h) shall be (1 m × 1 m × 1 m) or (1 m × 1 m × 0.5 m) or (2 m × 1 m × 1 m) or (2 m × 1 m × 0.5 m) or as agreed to between the buyer and the seller. The tolerance on dimensions of the gabion shall be ± 5 percent.

7 REQUIREMENTS

7.1 The synthetic polymer rope gabions for coastal and waterways protection shall meet the constructional and performance requirements as specified in Table 1.

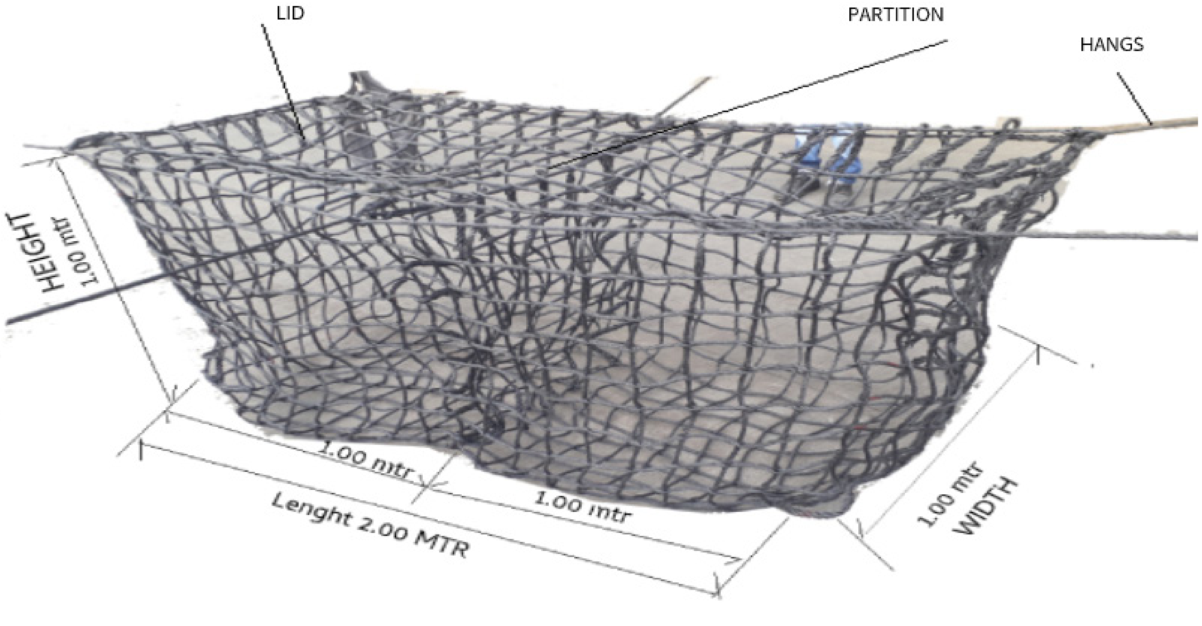


Fig. 3 Schematic Diagram of Synthetic Polymer Rope Gabion

Table 1 Requirements of Synthetic Polymer Rope Gabions for Coastal and Waterways Protection

(*Clauses* 5.1 *and* 7.1)

Sl No.	Characteristic	Requirement										Method of Test, Ref to
		Type 1					*Type 2*					
(1)	(2)	(3)					(4)					(5)
i)	Mesh opening size, mm, nominal (with a tolerance of ± 5 percent)	100 × 100					150 × 150					–
ii)	Rope diameter, nominal, mm	8	9	10	12	16	8	9	10	12	16	IS 7071
iii)	Linear density of the rope, ktex (with a tolerance of ± 10 percent)	30	40	45	65	116	30	40	45	65	116	IS 7071
iv)	Mass in kg per square meter of gabions, nominal (with a tolerance of ± 5 percent)	0.8	1.0	1.2	1.7	3.0	0.6	0.8	0.9	1.3	2.3	Annex B
v)	Breaking strength of rope, *Min*, kN (*see* Note)	10	13	14	19	34	10	13	14	19	34	IS 7071
vi)	Breaking strength after abrasion resistance of rope for 1 000 cycles, *Min*, kN (*see* Note)	9	11	12	17	30	9	11	12	17	30	Annex C
vii)	Breaking strength after thermal stability at 45 °C for 3 hours, kN, *Min* (*see* Note)	9	11	13	17	30	9	11	13	17	30	Annex D
viii)	Rope net strength, *Min*, kN/m (*see* Note)	85	105	120	160	250	60	75	85	113	200	Annex E
ix)	Punching shear strength, *Min*, kN	50	60	70	80	100	40	50	60	70	80	Annex F
x)	Retention in breaking strength of rope after UV exposure, percent, *Min*	70	70	70	70	70	70	70	70	70	70	Annex G and IS 7071
xi)	Retention in breaking strength after exposure to saline water cyclic corrosion test for 168 h	90	90	90	90	90	90	90	90	90	90	Annex H and IS 7071

NOTE — For ropes with eye spliced terminations, the breaking strength shall be 90 percent of the given strength.

8 MARKING AND LABELLING

8.1 The synthetic polymer rope gabions shall be marked with the following information by attaching the printed labels:

a) Manufacturer's name, initials or trademark;
b) Identification of the material that is, Polypropylene Polymer Gabions for coastal/waterways protection;
c) Type of synthetic polymer rope gabion and rope diameter;
d) Dimensions (length × width × height) of synthetic polymer rope gabion;
e) Lot number and date of manufacture;
f) The country of origin; and
g) Any other information/instruction provided by the manufacturer/required under law.

8.2 BIS Certification Marking

The synthetic polymer rope gabions conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the synthetic polymer rope gabions may be marked with the Standard Mark.

9 PACKING

The synthetic polymer rope gabions shall be supplied in folded form in bundles. Synthetic polymer rope gabions shall be packed in a HDPE raffia fabric in such a way to prevent it from the adverse impact of heat and moisture, grease, dirt, dust and other stains as well as to protect them from ultra-violet exposure during shipment and storage, prior to deployment and placement. Synthetic polymer rope gabions may also be packed as agreed to between the buyer and the seller.

10 STORAGE AND HANDLING

10.1 During storage, synthetic polymer rope gabions shall be elevated off the ground and adequately protected from the following:

a) Site construction damage;
b) Excessive precipitation;
c) Extended exposure to sunlight;
d) Aggressive chemicals;
e) Flames or temperatures in excess of 71 °C;
f) Excessive mud, wet concrete, epoxy, or other deleterious materials coming in contact with and affixing to the material; and
g) Any other environmental condition that may damage the physical property values of reinforcement.

10.2 The synthetic polymer rope gabions shall be laid flat during storage.

10.3 The synthetic polymer rope gabions shall be kept dry until installation, and shall not be stored directly on the ground.

10.4 The bundles shall be stored in a manner which protects them from adverse impact of weather. If stored outdoors, these shall be elevated and protected with a waterproof cover.

11 SAMPLING AND CRITERIA FOR CONFORMITY

11.1 Lot

The number of synthetic polymer rope gabions of same size and type delivered to a buyer against one dispatch note shall constitute a lot.

11.2 Unless otherwise agreed to between the buyer and the seller, the number of synthetic polymer rope gabions to be selected from a lot shall be in accordance with Table 2. The synthetic polymer rope gabions shall be selected at random with the use of random number tables (*see* IS 4905).

11.3 The conformity of the lot to the requirements of this standard shall be determined on the basis of the tests on the samples selected from it.

Table 2 Scale of Sampling

(*Clause* 11.2)

Sl No. (1)	No. of Gabions in Lot (2)	Sample Size (3)	Sub-Sample Size (4)	Permissible No. of Defective Gabions (5)
i)	Up to 50	3	2	0
ii)	51 - 150	5	2	0
iii)	151 - 500	8	3	1
iv)	501 - 3200	13	5	2
v)	3201 and above	20	5	3

11.4 Number of Test Specimens and Criteria for Conformity

Number of test specimens and criteria for conformity shall be as given in Table 3.

Table 3 Number of Test Specimens and Criteria for Conformity

(*Clause* 11.4)

Sl No. (1)	Characteristic (2)	No. of Gabions (3)	Criteria for Conformity (4)
i)	Material, manufacture, size, mesh opening size and rope diameter	According to column 3 of Table 2	The defective gabions shall not exceed the corresponding number given in column 5 of Table 2
ii)	All other requirements	According to column 4 of Table 2	All the test specimens shall pass the test

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
4905 : 2015	Random sampling and randomization procedures (*first revision*)
5175 : 2014	Fibre ropes — Polypropylene split film, monofilament and multifilament (PP2) and polypropylene high- tenacity multifilament (PP3) – 3-, 4-, 8- and 12-strand ropes (*third revision*)
7071 : 2021	Fibre ropes — Determination of certain physical and mechanical properties (*second revision*)

ANNEX B

[*Table* 1, *Sl. No.* (iv)]

DETERMINATION OF MASS IN KG PER SQUARE METER

B-1 PRINCIPLE

The full gabions are to be taken for weight measurement and kilograms per square meter is calculated considering the dimensions of gabions including partitions, if any and hangs length.

B-2 TEST SPECIMENS

Three samples of full synthetic polymer rope gabions shall be taken randomly from a lot under consideration.

B-3 APPARATUS

B-3.1 Weighing Balance, Capable of weighing to an accuracy of 0.01 kg.

B-3.2 Graduated Measuring Tape

B-4 TEST CONDITIONS

The testing shall be carried out at ambient temperature preferably at 27 °C.

B-5 PROCEDURE

B-5.1 Measure the dimensions of gabion accurately by graduated measuring tape for length, width and height. Measure all the six sides of gabions including the lid of the gabion.

B-5.2 Measure height and width of the partition/s, if any. Now calculate the total surface area of partitions in m^2.

B-5.3 Measure the length of the hang portion from body of the gabion.

B-5.4 Now weigh the gabion on weighing balance with an accuracy of minimum 0.01 kg. Carefully place the gabion on weighing balance to avoid any part of gabion touching to the ground.

B-5.5 Report the mass of the gabion, in kg.

B-5.6 Repeat the procedure for other two samples. Calculate the average weight of 3 gabions in kg/m^2 (*see* **B-6**).

B-6 CALCULATION

Determine the weight per square meter including hangs as follows:

$$\text{Weight per square meter of the gabion, kg/m}^2 = \frac{W}{A}$$

where

W = Total weight of gabion, in kg (*see* Note); and

A = Total surface area of the gabion including partition area, in m^2.

NOTE — The total weight of gabion includes hangs of 1.5 m length. The total weight will vary if hangs of other lengths (hang lengths) are used. In such cases the total gabion weight shall be determined by calculating the actual weight of the hang.

ANNEX C

[*Table* 1, *Sl. No.* (vi)]

ABRASION RESISTANCE TEST

C-1 PRINCIPLE

The test specimens are subjected to abrade for 1 000 cycles over an abrasion roller and breaking strength before and after the test is determined.

C-2 TEST SPECIMENS

Six specimens of ropes shall be taken, of which breaking strength on 3 samples shall be tested before abrasion and 3 after abrasion cycle. The effective test length of the specimens shall be 1 000 mm.

C-3 APPARATUS

C-3.1 Abrasion Tester, capable of testing ropes of diameters ranging from 8 mm to 16 mm. The abrasion tester shall have traverse motion. The roller shall have 125 mm diameter and diamond shape knurling of 45 to 50 Rockwell C hardness. The schematic diagram of abrasion tester is given in Fig. 4.

C-3.2 Tensile Tester, [*see* IS 7071].

C-4 TEST CONDITIONS

The testing shall be carried out in standard temperature of 27 ± 2 °C.

C-5 PROCEDURE

C-5.1 Three specimens shall be tested for breaking strength as per the method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

C-5.2 Remaining 3 test specimens shall be placed over the abrasion roller of the abrasion tester.

C-5.3 Axial load of minimum 5 kg shall be applied to the rope on the machine in order to straighten the rope during testing.

C-5.4 The traverse of the abrasion tester shall be kept fixed at 60 cm and the number of cycles per minutes shall be 4. (1 cycle = 1 double stroke).

C-5.5 The abrasion tester shall be allowed to abrade the test specimens for a minimum of 1 000 abrasion cycles.

C-5.6 After 1 000 cycles of abrasion, the samples shall be tested for breaking strength as per method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

C-6 CALCULATION

Determine the percent retention of original strength as follows:

Percent retention of original breaking strength =

$$\frac{b}{a}\times 100$$

where

a = average breaking strength of specimens before abrasion test; and

b = average breaking strength of specimens after 1 000 cycles of abrasion.

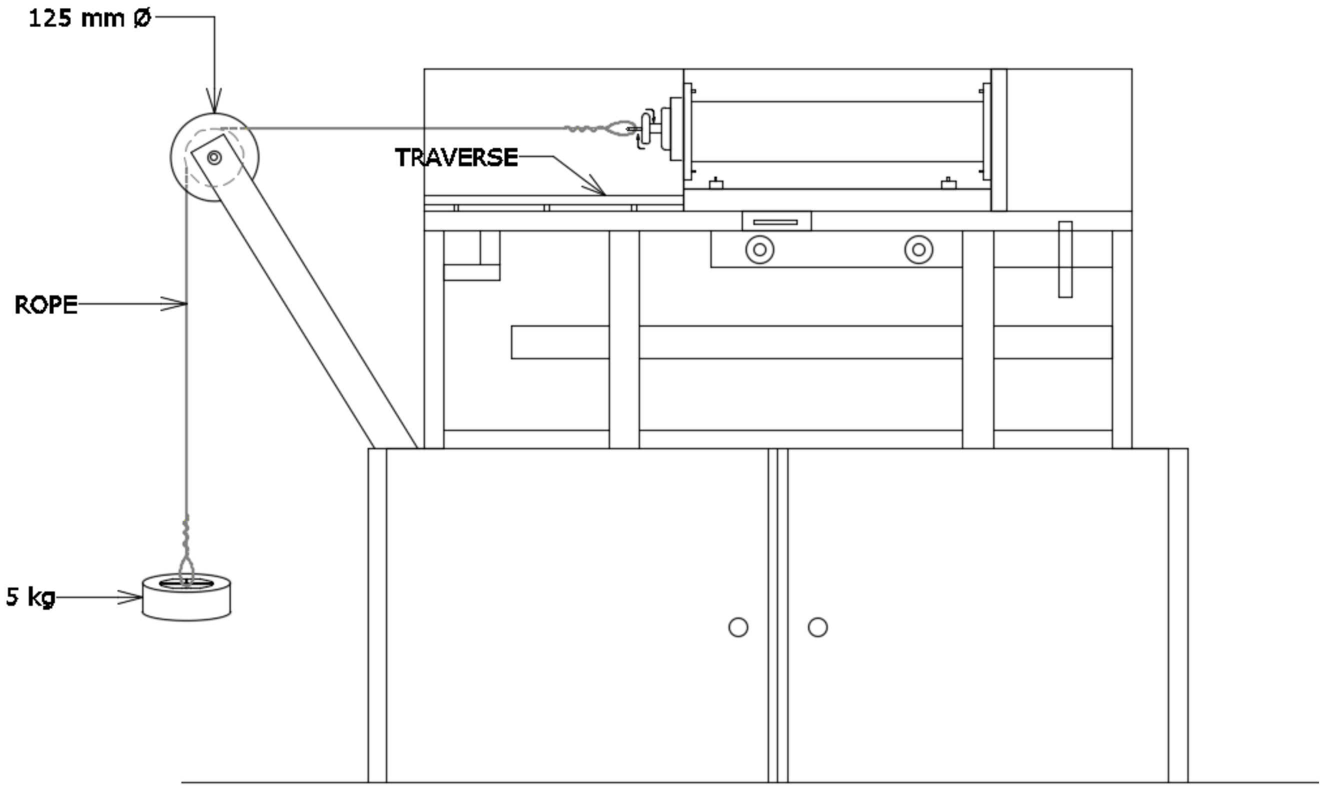


Fig. 4 Abrasion Tester

ANNEX D

[*Table* 1, *Sl. No.* (vii)]

THERMAL STABILITY TEST

D-1 PRINCIPLE

The test specimens are subjected to thermal stability test and breaking strength before and after the test is determined.

D-2 TEST SPECIMENS

Six specimens of ropes shall be taken, of which breaking strength on 3 samples shall be tested before thermal stability test and 3 after test. The effective test length of the specimens shall be 1 000 mm.

D-3 APPARATUS

D-3.1 Water Bath, of sufficient capacity such that specimens completely dip into the water. Temperature range of the bath shall be up to 99 °C with an accuracy of 0.1 °C. The water bath shall be provided with a stirrer to ensure temperature uniformity throughout the bath during the test.

D-3.2 Tensile Tester, [*see* IS 7071].

D-4 TEST CONDITIONS

The testing shall be carried out in standard temperature of 27 ± 2 °C.

D-5 PROCEDURE

D-5.1 Three specimens shall be tested for breaking strength as per method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

D-5.2 Remaining 3 test specimens shall be immersed in hot water bath, maintained at 45 ± 2 °C, for at least 3 h.

NOTE — If required, a nominal weight may be kept on the specimens to completely immerse them into hot water.

D-5.3 After the completion of test time (that is, 3 h), the specimens shall be taken out of the bath.

D-5.4 Breaking strength of these 3 test specimens shall be determined as per method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

NOTE — Test specimens shall be tested for breaking strength within 10 min after removal from the bath.

D-6 CALCULATION

Determine the percent retention of original strength as follows:

Percent retention of original breaking strength =

$$\frac{b}{a}\times 100$$

where

a = average breaking strength of the test specimens before test; and

b = average breaking strength of the test specimens after test.

ANNEX E

[*Table* 1, *Sl. No.* (viii)]

BREAKING STRENGTH TEST OF ROPE NET

E-1 TEST SPECIMENS

E-1.1 Three specimens of rope net shall be taken from the synthetic polymer rope gabion.

E-1.2 For testing breaking strength on rope net of 100 × 100 mesh size, a test piece of 500 mm width comprising six ropes shall be used.

E-1.3 For testing breaking strength on rope net of 150 mm × 150 mm mesh size, a test piece of 450 mm width comprising four ropes shall be used.

E-1.4 The effective test length of the specimen shall be 1 000 mm.

E-2 APPARATUS

E-2.1 Tensile Tester, [*see* IS 7071].

E-2.1.1 The tensile testing machine shall be equipped with suitable grips that do not allow specimen to slip from the grips (*see* Fig. 5).

E-3 TEST CONDITIONS

The testing shall be carried out in standard temperature of 27 ± 2 °C.

E-4 TEST PROCEDURE

E-4.1 Place the specimens on the tensile tester such that the specimens are gripped between the grippers. The rate of traverse of the straining head of the tensile testing machine shall be 200 mm/min ± 10 percent.

E-4.2 The breaking strength of the net shall be that load at which breakage in any one rope takes place. Maximum force (at break) shall be recorded.

E-5 CALCULATION

The breaking load per meter width of rope netting shall be calculated by using following formula:

$$\text{Rope net strength/m} = \frac{\text{Breaking load of test piece}}{\text{Width of the test specimen in meter (w)}}$$

where, w = 0.5, for 100 × 100 mesh size

and w = 0.45, for 150 × 150 mesh size

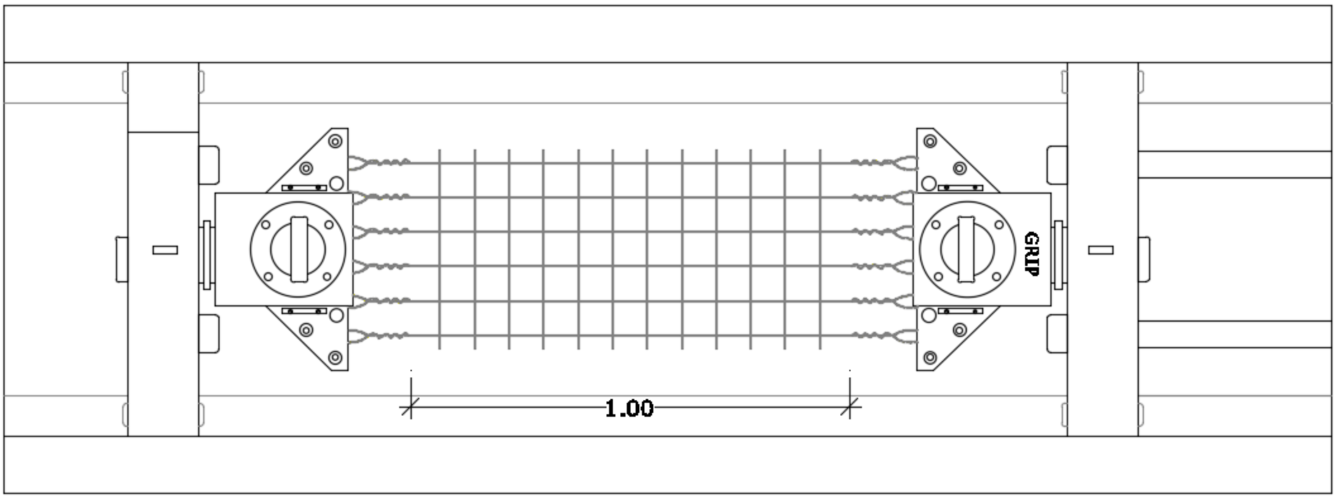


FIG. 5 SCHEMATIC DIAGRAM OF GRIPPERS USED

ANNEX F

[*Table* 1, *Sl. No.* (ix)]

PUNCHING SHEAR STRENGTH OF NETS

F-1 TEST SPECIMENS

The sample of the net to be tested shall be of size 1 500 mm × 1 500 mm. One sample of the net shall be prepared from the rope from coil which is being used to manufacture the synthetic polymer rope gabion. The ends of the ropes shall be eye spliced to secure the ends in the frame.

F-2 APPARATUS

F-2.1 Tensile Tester, [*see* IS 7071].

F-2.2 Test Frame, of 1 000 mm × 1 000 mm dimension which is attached to tensile tester. The frame shall have arrangements for tying the eye spliced ends of specimens.

F-2.3 Metal Bearing Plate, of 800 mm × 800 mm dimension having weight of 100 ± 5 kg.

F-3 TEST CONDITIONS

The testing shall be carried out in standard temperature of 27 ± 2 °C.

F-4 TEST PROCEDURE

F-4.1 The net shall be tightly stretched over the edges of the frame and secured.

F-4.2 The stretch in the net shall be such that the sag of the net at the midpoint shall not be more than 50 mm.

F-4.3 A punching force perpendicular to the plane of the net shall be applied at traverse rate of 200 mm/min ± 10 percent through the bearing plate. The schematic diagram of punching shear tester is shown in Fig. 6.

F-4.4 The force shall be applied until the rupture point is achieved.

F-4.5 Maximum force indicated (at break) shall be recorded.

F-5 REPORT

The maximum force achieved to rupture the net shall be the punching shear strength of net.

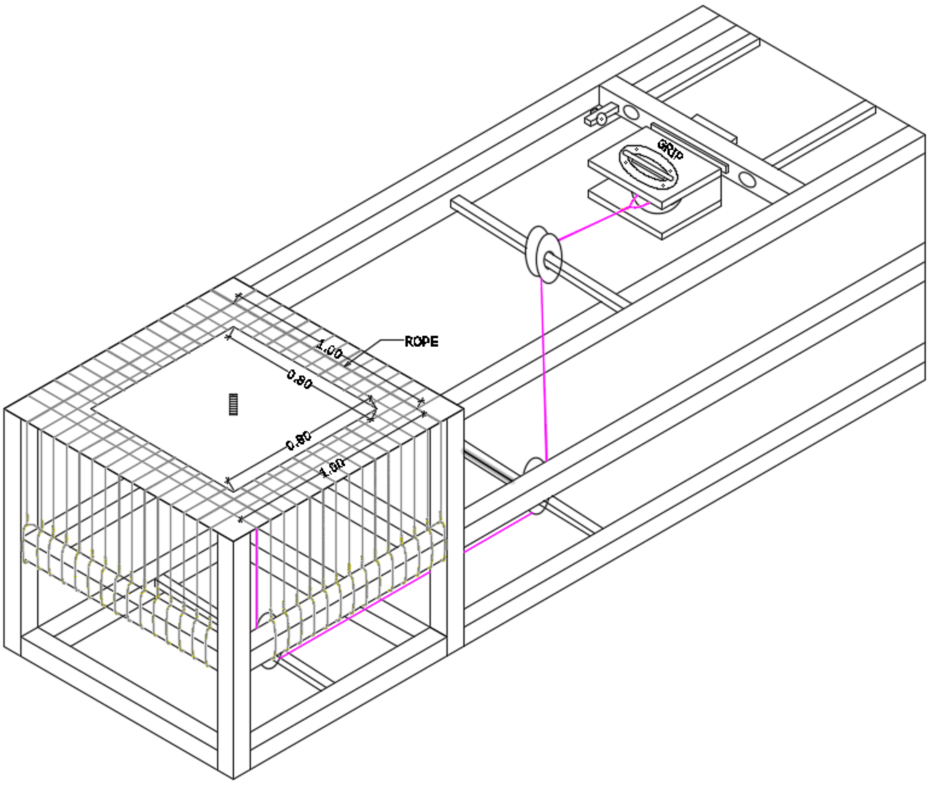


FIG. 6 PUNCHING SHEAR TESTER

ANNEX G

[*Table* 1, *Sl. No.* (x)]

UV RESISTANCE TEST

G-1 TEST SPECIMENS

Six specimens of ropes shall be taken, of which breaking strength on 3 samples shall be tested before UV exposure test and 3 after test. The effective test length of the specimens shall be 1 000 mm.

G-2 TEST CONDITIONS

G-2.1 The test shall be carried out with fluorescent UV-B lamp (313 nanometer or its equivalent).

G-2.2 The duration of the test shall be 500 h.

G-2.3 The test cycle shall be 8 h at 60 ± 3 °C with UV radiation alternating after 4 h at 50 ± 3 °C with condensation.

G-2.4 Irradiation level throughout the test shall be maintained at $0.63^{+0.03}_{-0.0}$ W/m².

G-3 TEST PROCEDURE

G-3.1 Determine the original average breaking strength of 3 rope specimens separately as per the test method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

G-3.2 Expose the remaining 3 specimens to ultraviolet light alone and to condensation in one respective cycle.

G-3.2.1 The type of fluorescent UV lamp, the timing of the UV exposure and the temperature of condensation shall be as specified in **G-2**.

G-3.3 Determine the average breaking strength of the specimens separately after UV exposure as mentioned above. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

G-3.4 Determine the percent retention of original strength as follows:

Percent retention of original breaking strength =

$$\frac{b}{a} \times 100$$

where

a = average breaking strength before UV exposure as obtained, in **G-3.1**; and

b = average breaking strength after UV exposure as obtained, in **G-3.3**.

NOTES

1 The UV source is an array of fluorescent lamps (with lamp emission concentrated in the UV range).

2 Condensation is produced by exposing the test surface to a heated, saturated mixture of air and water vapour, while the reverse side of the test specimen is exposed to the cooling influence of ambient room air.

ANNEX H

[*Table* 1, *Sl. No.* (xi)]

RETENTION IN BREAKING STRENGTH AFTER EXPOSURE TO SALINE WATER CYCLIC CORROSION TEST FOR 168 HOURS

H-1 PRINCIPLE

Test specimens are exposed to saline water and dry conditions sequentially over a period to simulate the actual end use conditions and breaking strength before and after the test cycles is determined.

H-2 TEST SPECIMENS

Six specimens of ropes shall be taken, of which breaking strength on 3 samples shall be tested before exposure and 3 after exposure. The effective test length of the specimens shall be 1 000 mm.

H-3 APPARATUS

H-3.1 Tensile Tester, [*see* IS 7071].

H-3.2 Hot Bath, of sufficient capacity such that specimens completely dip into the saline water. Temperature range of the bath shall be up to 99 °C with an accuracy of 0.1 °C. The hot bath shall be provided with a stirrer to ensure temperature uniformity throughout the bath during the test.

H-4 CHEMICALS

H-4.1 Saline Water Preparation

H-4.1.1 A test solution of 4 percent saline water by mixing 4 kg of salt in 100 L of water shall be prepared to submerge the test specimens into it.

H-4.1.2 The solution shall be mixed thoroughly so as to ensure complete dissolution in water.

H-5 TEST CONDITIONS

The testing shall be carried out in standard temperature of 27 ± 2 °C.

H-6 TEST PROCEDURE

H-6.1 Three specimens shall be tested for breaking strength as per method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

H-6.2 Remaining 3 test specimens shall be completely immersed in the hot bath having the saline water, for a period of 6 h. The hot bath containing the saline water shall be maintained at 45 ± 2 °C throughout the test (Step 1).

NOTE — If required, a nominal weight may be kept on the specimens to completely immerse them into hot water.

H-6.3 The samples shall be removed from the saline water hot bath and shall be kept at 27 ± 2 °C temperature for 6 h (Step 2).

H-6.4 The steps stipulated in **H-6.2** and **H-6.3** shall be considered as 1 complete exposure cycle.

H-6.5 Repeat the procedure on 3 test specimens for 14 complete exposure cycles.

H-6.6 After exposure of 14 cycles, the samples shall be tested for breaking strength as per method specified in IS 7071. The rate of traverse of the straining head of the testing machine shall be 200 mm/min ± 10 percent.

H-7 CALCULATION

Determine the percent retention of original strength as follows:

Percent retention of original breaking strength =

$$\frac{b}{a} \times 100$$

where

a = average breaking strength of test specimens before exposure; and

b = average breaking strength of test specimens after exposure to saline water.

ANNEX J

(*Foreword*)

GUIDELINES FOR STORAGE AND INSTALLATION OF SYNTHETIC POLYMER ROPE GABION

J-1 STORAGE OF SYNTHETIC POLYMER ROPE GABIONS

J-1.1 During storage, synthetic polymer rope gabions shall be elevated off the ground and adequately protected from the following:

a) Site construction damage;
b) Excessive precipitation;
c) Extended exposure to sunlight;
d) Aggressive chemicals;
e) Flames or temperatures in excess of 71 °C;
f) Vandalism and theft;
g) Rodent attack;
h) Excessive mud, wet concrete, epoxy, or other deleterious materials coming in contact with and affixing to the material; and
j) Any other environmental condition that may damage the physical property values of reinforcement.

J-2 QUALITY OF ROCK/STONE FILL

J-2.1 It should be ensured that the correct quality, grading and quantity of rock is available for the completion of the works. Rock used should be clean, durable and shall be obtained from a commercial crushing source or as per engineer's specification.

J-2.2 For synthetic polymer rope gabions, the rock should be well graded between 150 mm and 250 mm, and should have a minimum specific gravity of 2.3. A well packed gabion ensures better performance of the gabion structure.

J-2.3 Where ever possible, on environmental considerations, select and well graded fill of concrete /stone should be used that being obtained from the demolition of RCC, concrete, stone building structures.

J-3 GABION CONSTRUCTION FRAME

J-3.1 For ease of filling and alignment of the structure, both horizontally and vertically, and to obtain the correct lines and levels, the use of a gabion construction frame is recommended. The frame further assists in minimizing bulging during filling and ensures that the finished structure is aesthetically pleasing. These steel frames are then removed after filling the stones in the synthetic polymer rope gabion.

J-3.2 The schematic diagram of gabion construction frame is given in Fig. 7A and Fig. 7B.

J-4 PLACING OF GEOTEXTILE

J-4.1 Geotextiles prevent the loss of fines from the soil behind the gabion structure through the rock fill and simultaneously negate the buildup of any water pressure behind the wall. The omission of the geotextile is detrimental to the integrity of the structure as a whole. Cut sufficient geotextile to line the structure along the soil-gabion interface.

J-4.2 Place the geotextile on the prepared foundation, with the remaining geotextile temporarily draped along the backfill. The gabion shall be placed on the geotextile lined foundation.

J-4.3 It shall be ensured that the geotextile is not torn or ripped during the placing and filling of the basket, or the placing and compacting of the backfill. During construction, ensure contact between the geotextile and the back face of the gabion structure. If required, tie the geotextile to the top of the gabion structure to facilitate construction.

J-4.4 When overlapping of the geotextile is required, minimum overlapping of 300 mm shall be done. Diagram showing the placement of geotextile is given in Fig. 8.

J-5 FOUNDATION PREPARATION

J-5.1 The foundation on which gabions are to be placed shall be level, and graded to the elevations as shown on the project construction drawings. All depressions shall be carefully backfilled with sand filled empty cement bags. The foundation for gabions shall be smooth, and free from surface irregularities, loose material, and vegetation, in accordance with the project specifications. The foundation shall be compacted to the engineer's specification to ensure uniform bearing capacity and minimise differential settlements.

J-5.2 Diagram showing the foundation preparation is given in Fig. 9.

J-6 FILLING AND LACING OF SYNTHETIC POLYMER ROPE GABIONS UNITS

J-6.1 Stones shall be carefully placed manually to avoid damage to the polymer rope and to minimize voids between the fillings. Filler stone shall be hard, durable, and clean. It shall naturally resist crumbling, flaking and eroding. Undue deformation and bulging of the gabion shall be corrected prior to further stone filling. To avoid localized deformation, the gabion unit in any row is to be filled in stages consisting of maximum

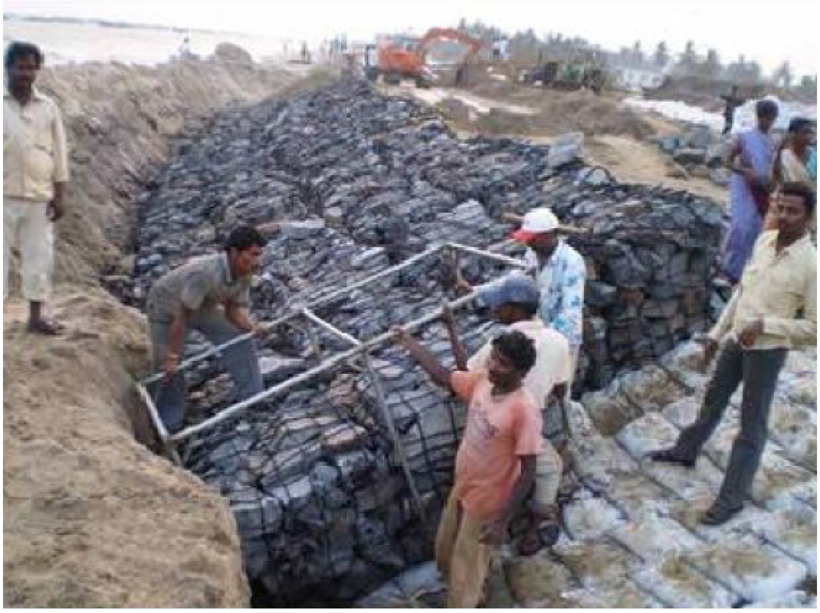


Fig. 7A

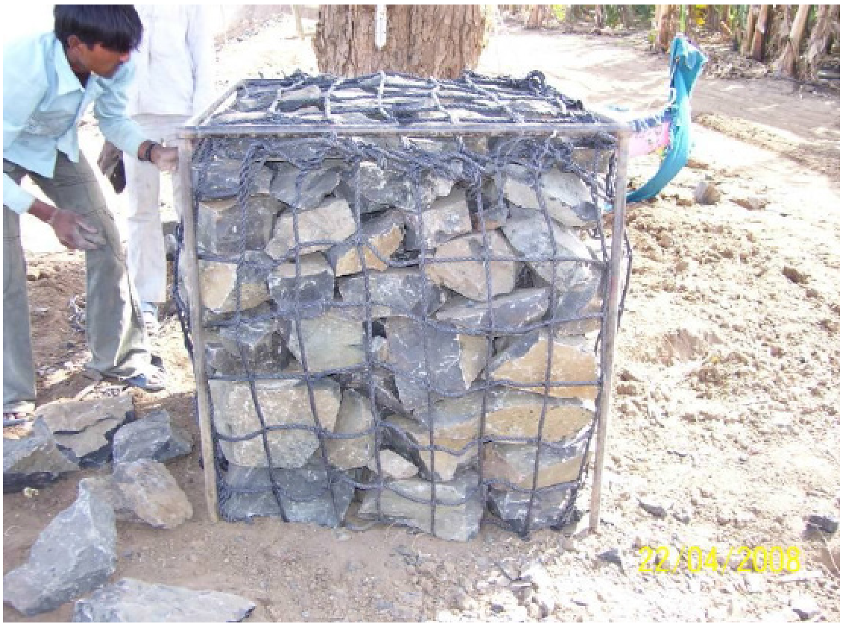


Fig. 7B

Fig. 7 Gabion Construction Frame

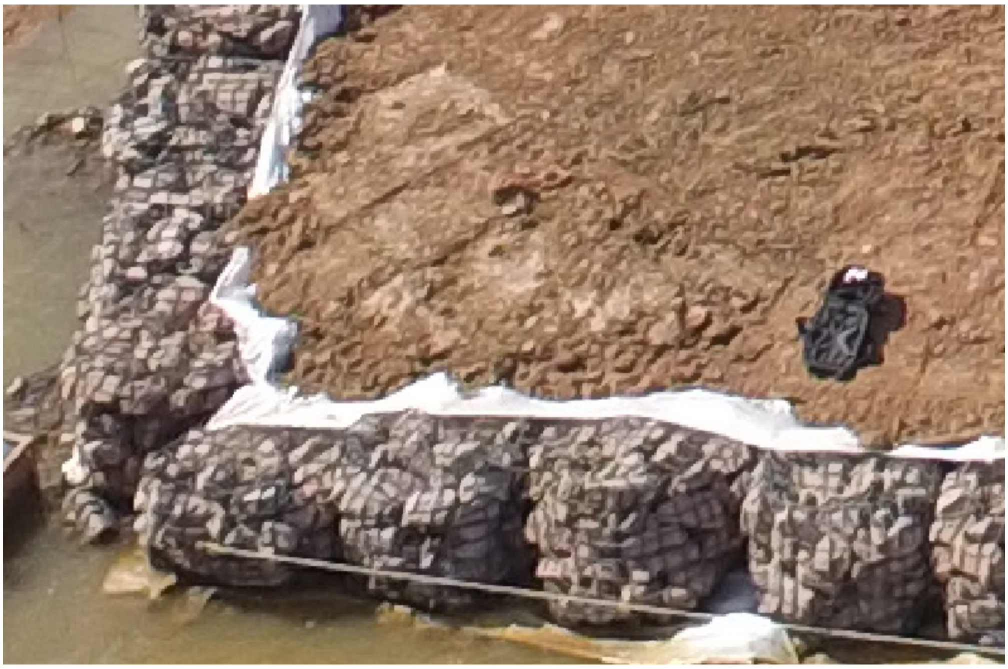


Fig. 8 Placement of Geotextile

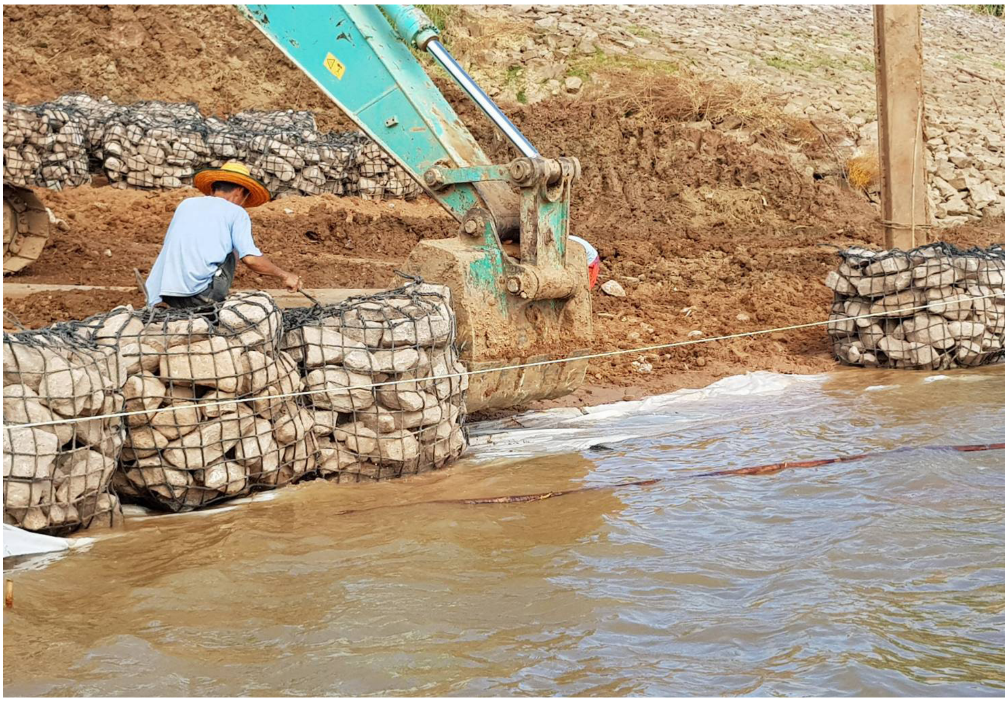


Fig. 9 Foundation Preparation

300 mm coarses. At no time, any cell shall not be filled to a depth exceeding 300 mm more than the adjoining cell.

J-6.2 Maximum height from which the stone may be dropped in to the gabion shall not be more than 1 m. Along all exposed faces, the outer layer of stone shall be carefully placed and arranged by hand if required to ensure a neat and compact appearance. Last top layer of stone shall be uniformly overfilled 25 to 50 mm for gabions to compensate for the future settlement in rock but still allow for the proper closing of the lid and to provide an even surface, which is uniform in appearance.

J-6.3 Lids shall be stretched tight over the stone fill until the lid meets the perimeter edges of the front and end panels. The lid shall be tied with all edges of gabion. Repeat the procedure up to the required height and length as specified in the drawings.

J-7 LACING ROPE FOR BINDING OPERATIONS

J-7.1 Lacing rope shall be used to assemble and interconnect gabion units, to close and secure stone filled units. Sufficient lacing rope shall be supplied by manufacturer in rolls with each unit to enable assembly.

J-7.2 The schematic diagram of lacing/bracing of polymer rope gabion unit is given in Fig. 10.

J-8 LIFTING AND PLACING OF SYNTHETIC POLYMER ROPE GABIONS

J-8.1 The Synthetic polymer rope gabions can be filled insitu or away from the proposed location. If gabions are filled away from proposed location, suitable arrangement of frame for filling and lifting shall be arranged.

J-8.2 Diagrams showing the lifting and placing of synthetic polymer rope gabions is given in Fig. 11A, Fig. 11B and Fig. 11C.

J-9 BACKFILING

J-9.1 Compaction of the backfill shall be done simultaneously with every row of gabions laid. Care shall be taken not to damage the geotextile when placing and compacting the backfill. Heavy compaction equipment shall not come within 2 m of the gabion basket.

J-9.2 Small hand held compaction equipment may be used adjacent to the gabion basket.

J-10 SCHEMATIC REPRESENTATION

The schematic diagram showing the different stages of installation of synthetic polymer rope gabions is given in Fig. 12.

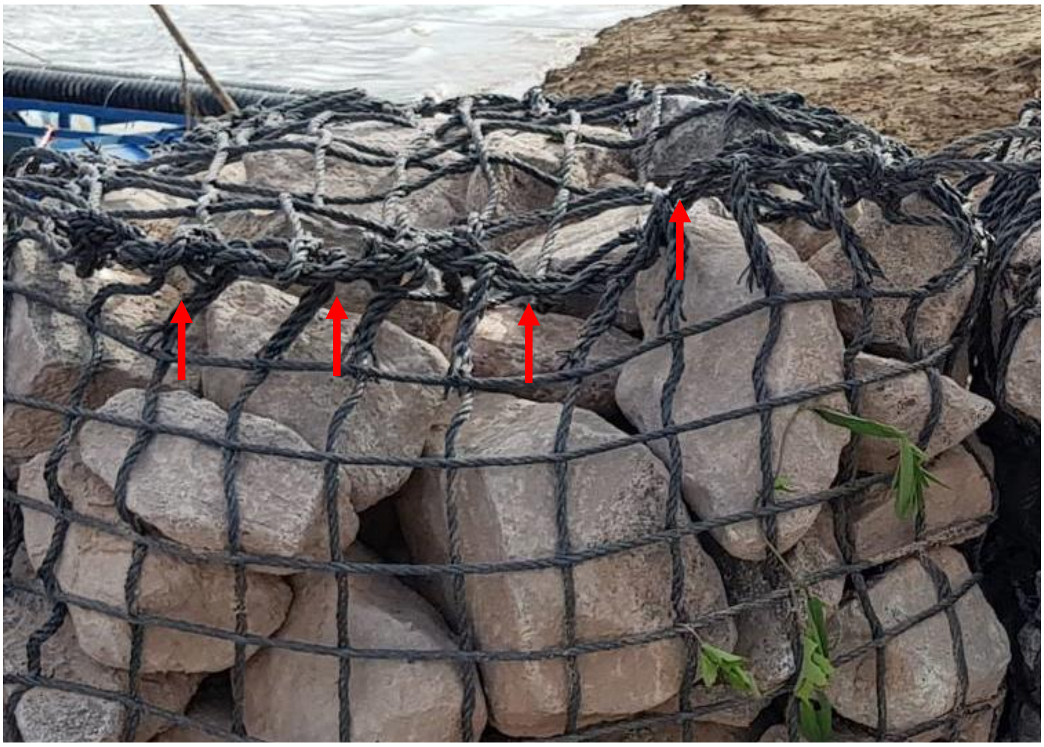


Fig. 10 Lacing/Bracing of Polymer Rope Gabion

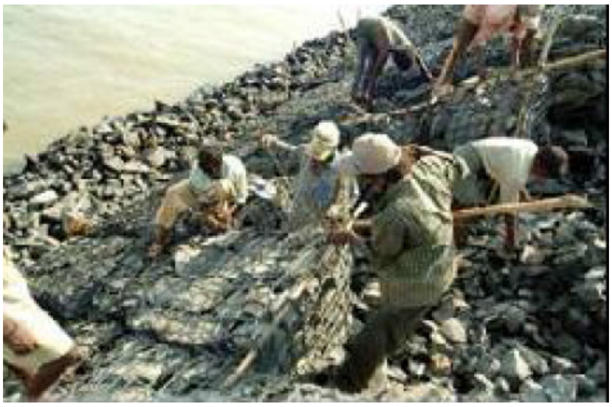


FIG. 11A

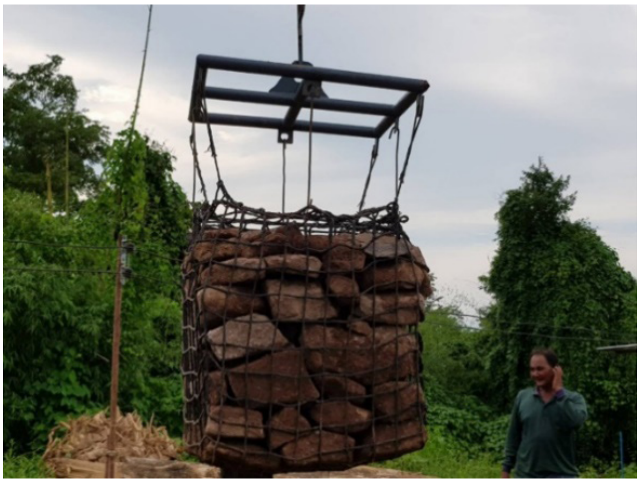


FIG. 11B

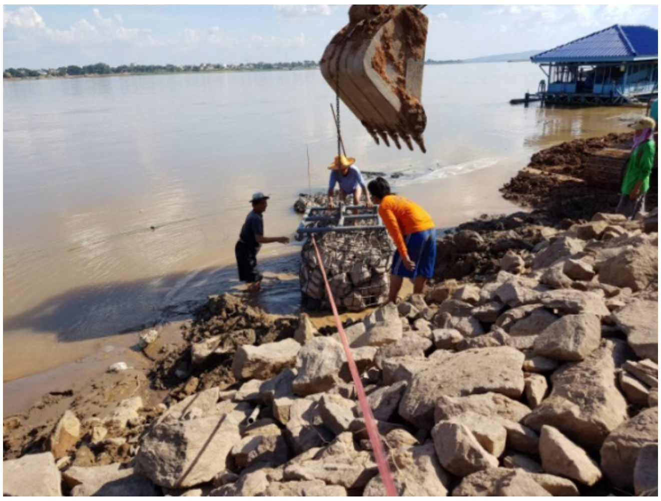
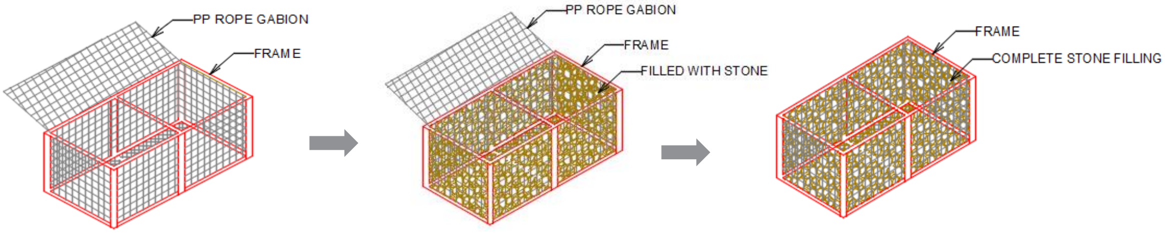


FIG. 11C

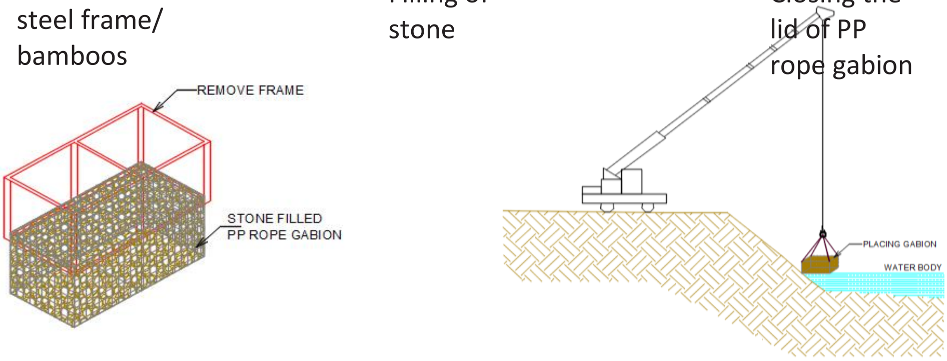
FIG. 11 LIFTING AND PLACING OF SYNTHETIC POLYMER ROPE GABIONS



Stage 1:
Placing of
steel frame/
bamboos

Stage 2:
Filling of
stone

Stage 3:
Closing the
lid of PP
rope gabion



Stage 4: Removal
of frame

Underwater
installation

FIG. 12 SCHEMATIC DIAGRAM SHOWING THE INSTALLATION OF SYNTHETIC POLYMER ROPE GABIONS

ANNEX K

(*Foreword*)

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